

CLAIMS

1. A multidirectional simultaneous observation optical system having at least one of one, two or more side face imaging prism systems for obtaining side face images of one, two or more side faces of an object to be inspected and a bottom face imaging prism system for obtaining a bottom face image,
5 the optical system being characterized in that each of the side face imaging prism systems has an optical path direction changing prism or an optical path direction changing prism function; the prism systems are provided by the side of an open space for obtaining an image of the top face of the object to be inspected so that the open space is secured right above the object to be
10 inspected, and so that an object mount space portion is secured; and the prism systems are placed so that the optical paths for light exiting the prism systems extend upward above the object to be inspected, or along the same direction in parallel with each other, and so that the optical path is not obstructed.
2. A multidirectional simultaneous observation optical system including one, two or more side face imaging prism systems for obtaining side face images of one, two or more side faces of an object to be inspected and a bottom face imaging prism system for obtaining a bottom face image, the
5 optical system being characterized in that each of the side face imaging prism systems and the bottom face imaging prism system has an optical path direction changing prism or an optical path direction changing prism function; the prism systems are provided so as to occupy side spaces around an open space for obtaining an image of the top face of the object to be inspected and
10 a space below the open space such that the open space is secured right above the object to be inspected, and such that an object mount space

portion is secured; and the prism systems are placed so that the optical paths for light exiting the prism systems extend upward above the object to be inspected, or along the same direction in parallel with each other, and so that the optical path from each prism system is not obstructed by any of the other
5 prism systems.

3. The multidirectional simultaneous observation optical system according to claim 1 or 2, characterized in that each of the side face imaging prism systems and the bottom face imaging prism system is provided with an optical path length correcting prism or an optical path length correcting prism function
5 above the optical path direction changing prism or the optical path direction changing prism function, the optical path length correcting prism or the optical path length correcting prism function being provided for the purpose of equalizing the working distance of the faces of the object to be inspected other than the top face of the same to the working distance of the top face.

4. The multidirectional simultaneous observation optical system according to claim 3, characterized in that the optical path length correcting prism or the optical path length correcting prism function is formed so as to be interchangeable or optical path length adjustable in order to make optical path
5 length correction according to the shape and size of the object to be inspected.

5. The multidirectional simultaneous observation optical system according to claim 3 or 4, characterized in that a 45° mirror prism or a prism having a 45° mirror prism function is used as the optical path direction changing prism or the optical path direction changing prism function in the side face imaging
5 prism system, and a trapezoidal prism or a triangular prism capable of changing the direction two times or a prism having the corresponding function

is used as the optical path direction changing prism or the optical path direction changing prism function in the bottom face imaging prism system.

6. The multidirectional simultaneous observation optical system according to any one of claims 3 to 5, characterized in that a penta prism capable of obtaining an erect image or a prism having the corresponding function is used as the optical path direction changing prism or the optical path direction
5 changing prism function in the side face imaging prism system.

7. The multidirectional simultaneous observation optical system according to any one of claims 1 to 6, characterized in that an optical path shifting prism or an optical path shifting prism function for shifting the optical path is provided above the optical path direction changing prism in each prism
5 system.

8. The multidirectional simultaneous observation optical system according to claim 7, characterized in that the optical path shifting prism or the optical path shifting prism function is formed so as to reduce the optical path section for optical output from the corresponding face of the object to be inspected, in
5 order to improve the resolution by reducing the area of light incident on a lens or the like.

9. The multidirectional simultaneous observation optical system according to any one of claims 3 to 8, characterized by having object carrying means on which two or more objects to be inspected are mounted and which can carry and move the objects to be inspected via the object mount space portion, and
5 characterized in that each prism system is placed so that a path for the object carrying means is secured.

10. The multidirectional simultaneous observation optical system according to any one of claims 3 to 9, characterized in that the four side face imaging prism systems are provided and image information on the object to be inspected can be obtained as light in six directions including the direction from the top face from which an optical output can be obtained without each prism system.

11. The multidirectional simultaneous observation optical system according to claim 10, characterized in that two pairs of side face imaging prism systems opposed to each other with the object mount space portion interposed therebetween are placed as the four side face imaging prism systems orthogonally to each other or at any angle from each other.

12. The multidirectional simultaneous observation optical system according to any one of claims 3 to 10, characterized by further including a lens facing along the optical output direction of the side face imaging prism system and the bottom face imaging prism system or a telecentric lens capable of forming a telecentric system on the side of the object to be inspected.

13. The multidirectional simultaneous observation optical system according to claim 12, characterized in that the lens has a depth of field sufficient for simultaneously adjusting in-focus planes for the faces even with respect to a complicated object to be inspected having a spherical or hyper-polyhedral shape or the like.

14. An image reading device characterized by having the multidirectional simultaneous observation optical system according to any one of claims 11 to 13 and an electronic image pickup device including a CCD, a CMOS or a line CCD for performing photoelectric conversion processing on light obtained

through the lens, and characterized in that the image reading device can be used for image analysis including image measurement.

15. An image reading method characterized by obtaining image information in the form of light on the faces of an object to be inspected by means of the multidirectional simultaneous observation optical system according to any one of claims 11 to 13, obtaining electrically processible image information by
5 performing photoelectric conversion processing on light obtained through the lens, by means of an electronic image pickup device including a CCD, a CMOS or a line CCD, and using the image information for image analysis including image measurement.

16. The multidirectional simultaneous observation optical system according to claim 1 or 2, characterized in that the open space is formed above the optical path direction changing prism or the optical path direction changing prism function in each of the side face imaging prism system and the bottom
5 face imaging prism system to enable visual observation with the human eye to be easily performed.

17. The multidirectional simultaneous observation optical system according to claim 16, characterized in that a triangular mirror prism or a prism having a triangular mirror prism function is used as the optical path direction changing prism or the optical path direction changing prism function in the side face
5 imaging prism system, and a trapezoidal prism or a triangular prism capable of changing the direction two times or a prism having the corresponding function is used as the optical path direction changing prism or the optical path direction changing prism function in the bottom face imaging prism system.

18. The multidirectional simultaneous observation optical system according to claim 16 or 17, characterized in that a pentagonal prism capable of obtaining an erect image or a prism having the corresponding function is used as the optical path direction changing prism or the optical path direction
5 changing prism function in the side face imaging prism system.

19. The multidirectional simultaneous observation optical system according to any one of claims 16 to 18, characterized in that an antireflection prism or an antireflection prism function is provided above the trapezoidal prism, the triangular prism or the corresponding function.

20. The multidirectional simultaneous observation optical system according to any one of claims 16 to 19, characterized by having object carrying means on which two or more objects to be inspected are mounted and which can carry and move the objects to be inspected via the object mount space portion,
5 and characterized in that each prism system is placed so that a path for the object carrying means is secured.

21. The multidirectional simultaneous observation optical system according to any one of claims 16 to 20, characterized in that the four side face imaging prism systems are provided and image information on the object to be inspected can be obtained as light in six directions including the direction from
5 the top face from which an optical output can be obtained without the prism system.

22. The multidirectional simultaneous observation optical system according to claim 21, characterized in that two pairs of side face imaging prism systems opposed to each other with the object mount space portion interposed

therebetween are placed as the four side face imaging prism systems orthogonally to each other or at any angle from each other.

23. A multidirectional simultaneous observation combined optical system characterized by using the two or more multidirectional simultaneous observation optical systems according to claim 1 or 2, and characterized in
5 that multidirectional simultaneous observation of an object to be inspected can be performed by means of the multidirectional simultaneous observation optical systems.